



NOTES ON FISHES IN THE COLLECTION OF THE QUEEN VICTORIA MUSEUM, LAUNCESTON.

PART 1

by

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ABSTRACT

Three species are added to the Tasmanian list: *Macroramphosus gracilis* (Lowe, 1839) (Macrorhamphosidae), *Pseudophycis breviuscula* (Richardson, 1846) (Moridae), *Physiculus marginata* (Günther, 1878) (Moridae). The two morids were determined by Dr Daniel M. Cohen. Some general observations are made on *Creedia haswelli* (Ramsay, 1881) (Creediidae).

The material provides examples of some interesting exponential size-number relations: in loglog plots (a) length of head, length to vent, standard length are linear on three integers, (b) lengths of certain radial elements are linear on their serial numbers ($L = bN^k$), (c) lengths to origins and terminations of vertical fins are linear on early natural numbers.

INTRODUCTION

Some interesting material in the collection of the Queen Victoria Museum and Art Gallery Launceston is examined. Linear dimensions are regularly given in millimetres, the name of the unit commonly being omitted. The symbols L_s , L_t , TL_s , TL_t denote, respectively, standard length, total length, thousandths of standard length, thousandths of total length. Standard deviation and derived statistics are calculated with $N-1$ degrees of freedom.

FAMILY MACRORAMPHOSIDAE

This family, the members of which are known vernacularly as Bellows fish, Snipe fish or Woodcock fish, names suggested by their characteristic form, is represented in Tasmania by 5 species: (a) *Notopogon lilliei* Regan, 1914 (b) *Notopogon endeavourii* Mohr, 1937 (c) *Centriscops humerosus* (Richardson, 1846) (d) *Macrorhamphosus elevatus* Waite, 1899 (e) *Macrorhamphosus gracilis* (Lowe, 1839). Opinions regarding specific status have differed considerably among writers concerned with the group (notably Regan (1914 a,b), Mohr (1937) and several local authors). Its history has not been without misidentifications, for example McCulloch (1911, 1914). Of the species listed above both (a) and (b) are recognized in the name-list of Whitley (1964), while Munro (1958) relegates (b) to the synonymy of (a) (if distinct, they are certainly closely allied). In both these sources (e), a species with a wide extralimital distribution, is represented by *Macrorhamphosus molleri* Whitley, 1930 (regarded as endemic), entered in the name-list as *Orthichthys molleri*. *Centriscops humerosus* is not credited to Tasmania in the Check-List (McCulloch 1929) or in the Handbook, and its appearance in the local lists of Lord (1923, 1927) and of Lord & Scott (1924) may be based on a misinterpretation of *Endeavour* reports by McCulloch (1911, 1914), no Tasmanian occurrences being given. A possibility mooted by Johnston in his first Tasmanian catalogue (1883) that his entry of *Centriscus scolopax* (= *Macrorhamphosus elevatus*), based on the MS list of Allport, might represent *Centriscus humerosus* was later (1885) wholly discounted by him. However, this species is expressly reported from this State by Whitley & Allan (1958). The history of the species that occur, or have been stated to occur, in Tasmanian waters has been reviewed in detail earlier (Scott 1961).

In the present paper *Macrorhamphosus gracilis* is for the first time reported from this State, and some observations are presented on a sample of *M. elevatus*.

KEY TO MACRORAMPHOSIDAE RECORDED FROM TASMANIA

1. Dorsals continuous or subcontinuous, first with 6-7 spines. Oblique extension of anal base $\leq 1\frac{1}{2}$ that of second dorsal base 2
- Dorsals wholly separate, first with 4-5 spines. Oblique extension of anal base > 2 that of second dorsal base 4
2. No lateral line. Ventral 1, 5. No tuft of bristles on head or nape
- Lateral line present. Ventral 1, 4. A tuft of bristles on head or nape. 3
3. Membrane of spinous dorsal weak, naked. Length of head \geq depth of body. Bristle patch usually extending to, or caudad of, level of opercular margin. Of height of body at ventral origin $\approx \frac{1}{2}$ above anteroposterior body axis
- Centriscops humerosus*
4. Membrane of spinous dorsal firm, scaly. Length of head \leq depth of body. Bristle patch usually not extending to level of opercular margin. Of height of body at ventral origin $\approx \frac{3}{5}$ above anteroposterior body axis
- Notopogon lilliei*
- Notopogon endeavourii*

4. Dorsal V, 12. Second dorsal spine strongly serrated behind, inserted over or slightly behind vent, nearer to caudal base than to head, distance between level of its insertion and that of caudal base ≈ 4 in standard length. Depth $> \frac{1}{2}$ in head. Reddish or yellowish. Total length to about 150 mm.

Macroramphosus elevatus

Dorsal IV, 9-12. Second dorsal spine feebly serrated behind, inserted distinctly in advance of vent, nearer to head than to caudal base, distance between level of its insertion and that of caudal base ≈ 3 in standard length. Depth $< \frac{1}{2}$ head. Greyish or bluish, partly silvery. Total length to about 100 mm

Macroramphosus gracilis

Genus *MACRORAMPHOSUS* Lacépède, 1803

Macroramphosus Lacépède, 1803, Hist. Nat. Poiss., 5: 136. Type-species, *Macroramphosus cornutus* Lacépède.

Macroramphosus Agassiz, 1845, Nom. Zool. (Pisces): 37, emendation for *Macroramphosus* Lacépède.

Orthichthys Gill, 1862: Proc. Acad. Nat. Sci. Philad., 5: 234. Type-species, *Centriscus velitaris* Pallas.

Macroramphosus gracilis (Lowe, 1839)

(Fig. 1B)

Centriscus gracilis Lowe, 1839, Proc. Zool. Soc. (Lond.), 7: 86. Type locality: Madeira.

Centriscus gracilis: Pedley, 1884, Proc. Linn. Soc. N.S.W., 9(1): 111; Macleay, 1884, Proc. Linn. Soc. N.S.W., 9(1): 42; Waite, 1899, Aust. Mus. Mem., 4(1): 61, pl.7 fig.2, and 1900, Rec. Aust. Mus., 3(7): 199; McCulloch, 1921, Aust. Zool., 2(2): 36, and 1929, Aust. Mus. Mem., 5(1): 83; Mohr, 1937, Dana rept., 13: 37; Paxton, Rec. Aust. Mus., 30(15): 389.

Centriscus gracilis var. *japonicus* Ogilby, 1886, Cat. fish. N.S.W.: 42. Type locality: Port Jackson. Not *Centriscus japonicus* Günther, 1886 (Japan).

Macroramphosus japonicus? Regan, 1914, Ann. Mag. Nat. Hist., 8, 13: 19 (New South Wales reference only).

Macroramphosus molleri Whitley, 1930, Aust. Zool., 6(2): 117. Type locality: Maroubra Beach, near Sydney, New South Wales. Holotype figured by Waite, 1899 (reference above).

Macroramphosus molleri: Munro, 1958, Handbk Aust. fish., 23: 95, fig. 654.

Orthichthys molleri: Whitley & Allan, 1958, Sea-Horse and its relatives: 71, text fig.21 no.2; Whitley, 1964, Proc. Linn. Soc. N.S.W., 89(1): 37.

NOTE ON SYNONYMY AND DIAGNOSIS

In proposing *Macroramphosus molleri* Whitley (1930: 117) observed, 'The Little Bellows Fish of New South Wales which has been called *Macroramphosus gracilis* by authors is apparently distinct from *Centriscus gracilis* Lowe. The second dorsal spine has few serrations, originates behind the vertical from the vent [our italics], and, in most specimens, when depressed, reaches the second dorsal fin [about two-thirds of distance in holotype]. Nine to twelve dorsal rays, eighteen to nineteen in anal; depth 5-5½ in total length [? standard length; so rendered in Handbook]. The New South Wales form, which I name *M. molleri*, is allied to *Centriscus japonicus* Günther, but Regan, who compared Günther's types with Waite's figure was uncertain to their identity. The holotype of *M. molleri* is the specimen figured by Waite, which came from Maroubra Beach near Sydney, New South Wales (Austr. Mus. Regd. No. B 7168)'. The sinking of Lowe's species in the synonymy of Whitley's, in respect of the Australian fish, was rejected by Mohr (1937: 37), but it was accepted in the Handbook (Munro 1958) and in Whitley's own and joint papers (Whitley & Allan 1958, Whitley 1964). It will be seen no formal comparison of *M. molleri* with *M. gracilis* was made; current opinion in general inclines to regard them as a single species of circumglobal distribution in tropical and subtropical waters including those of eastern Australia (Paxton 1976: 389). This view is adopted here; however a definitive determination perhaps remains a desideratum.

The italicized passage above is clearly in error. In this genus the vent is located (as in most fishes) shortly before anal origin (in both *M. gracilis* and *M. elevatus* separate from it by about its own modal diameter). In our example of *M. gracilis* the second dorsal spine originates well in advance of the vertical from the vent; reference to Waite's figure makes it evident this must also be the case in the holotype. Unfortunately the slip was carried over into the Handbook (Munro 1958: 95, fig.654, a reproduction of Waite's 1899 illustration): a similar specification occurs also in the description of the immediately following species, *M. velitaris* (Pallas, 1770), in which, as fig.655 makes clear, to be so located the vent would need to be at least so far forward as to lie beneath the adpressed ventral fin. Earlier, McCulloch (1922: 36) had correctly separated the two species in a key, describing *M. elevatus* with (second) 'dorsal spine over or a little before the vent', *M. gracilis* (under that name) with spine 'well before the vent'; and the correct situation was noted, subsequent to the description of *M. molleri*, in Whitley & Allan (1958: 71).

MATERIAL

A specimen, *Ls* 38.3 *Lt* 43.8, from north-east of George Rocks, east coast, collected by Mr T. Singline in November 1980 (Q.V.M. Reg. No. 1980/5/66).

MERISTIC CHARACTERS

D. IV, 10. A. 18. P. 14. V. 1, 5. C. 6 + 9 + 6. Only 4 dorsal spines were detected (see Aspects of form, below).

DIMENSIONS AS *TLs*

Length to origin of first dorsal 662, to termination 746, oblique (point-to-point) length of base 87; second dorsal 847 901 99; anal 705 929 204. Length to origin of pectoral 478, total length of fin 160, oblique length of base 33. Length to origin of ventral 578, total length of fin 38. Head 468. Snout 272. Eye 99. Interorbital 59. Length of lower jaw 56. Length to vent 695. Length of first dorsal spine 23, second 204, third 102, fourth 53. Length of longest dorsal ray 107, of longest anal ray 50. Depth at front of eye 130, at back of eye 196, at operculum 206, at dorsal origin 201, at vent 191; maximum depth 214, depth of caudal peduncle 48. Maximum thickness of head 87, of trunk 76.

DIAGNOSTIC PROPORTIONS

Values in parentheses preceded by M are those of the Handbook (Munro, 1958), those preceded by W are calculated from measurements of the figure of the holotype of *M. molleri* (Waite 1899, pl.7 fig.2). Head in *Ls* 2.14 (M '1.2' = ? 2.1, W 2.1). Depth in head 2.19 (M 2.3, W 2.4), in *Ls* 4.67 (M 5.5, W 4.9). Pectoral in head 2.92 (W 3.3), in *Ls* 6.24 (W 6.8). Snout in head 1.72 (M 1.5, W 1.5), in *Ls* 3.67 (W 3.0), in second dorsal spine 0.75 (W 0.3). Eye in head 4.72 (M 5.6, W 5.7), in snout 2.75 (W 3.9). Interorbital in eye 1.70. Second dorsal spine in head 2.28 (M 'less than 3', W 4.8), in *Ls* 4.91 (W 9.9): with regard to the much shorter relative length of the second dorsal spine in Waite's figure, where, if depressed, it would extend only about two-thirds of the distance towards the origin of the second dorsal, while in our specimen it would reach about to the level of the first one-third of the fin base, Whitley (1930: 117), though citing Waite's figure as the holotype of his *M. molleri* (= *M. gracilis*), remarked that in most specimens the depressed spine reaches the second dorsal fin. Maximum thickness in maximum depth 2.4, in *Ls* 11.6. Oblique length of second dorsal base in oblique length of anal base 2.06.

GENERAL FEATURES

Elongate, strongly compressed. Dorsal profile gently sigmoid to near first dorsal origin, the early concavity more marked than the posterior convexity, the segments subequal in length; interdorsal slightly sloping back and down, barely convex (less so than in Waite's figure); second dorsal base almost linear at an angle of about 45°. Ventral profile resolvable into four main segments; from tip of snout to below eye concave; briefly convex about to level of opercular border; close to linear to ventral, posteriorly curving down to produce a distinct small projection at origin of fin; to caudal peduncle barely convex. In the terminology of Gregory (1928) the general body form is specified thus: mesosomatic, gasterion postapical, apex median, gasterion median, mesonotic, mesogastric, leptoptygidial, opisthion posturanic.

Snout of relatively moderate length, compressed, half as wide at tip as at level of orbit; tip bluntly pointed, lower jaw slightly in advance of upper; rapidly increasing in depth backward to reach 0.6 maximum depth at orbit; slightly tilted upward, a line joining angle of rictus and middle of caudal peduncle crossing eye above its middle (in figure of holotype not tilted, this line tangential to, or slightly below, inferior border of pupil; approaching more closely figure of holotype of *M. elevatus* in same plate); lateral surface with three ridges, from lowest progressively less upwardly convex; lowest defining ventral profile from below first one-fourth of eye (where it is met at an angle of about 120° by a strong oblique linear ridge running down and forward from shortly behind middle of eye and touching orbit near 4 o'clock, left side viewed) to just behind end of lower jaw, middle from 9 o'clock on orbit subhorizontally forward, its anterior half constituting the dorsal profile, its posterior half surmounted by the uppermost ridge extending forward from the highest point of a complete elevated circumoral ring, the two meeting near middle of snout to enclose an elongate triangle of smooth black integument contrasting sharply with strongly rugose silvery rest of lateral surface of snout; near middle of length of this pennon, closer to its lower than its upper border, the two nostrils, each surrounded by a low broad rim, distance between the rounded openings subequal to the sum of their diameters; on dorsum of head a poorly developed median ridge arising at occiput and running forward continues with some interruption on to snout lapsing to extinction about midway between orbit and snout tip; rest of dorsal surface covered with low closely set longitudinal ridges of varying length.

Eye rather large, in upper two-thirds of head approaching fairly closely to dorsal profile, its diameter 2.75 in snout, subequal to its direct distances from upper and lower angles of branchial cleft, this latter evenly convex, reaching up to level of upper end of pectoral base. Mouth terminal, very small, length less than one-tenth snout. Operculum entire. From 2 o'clock on orbit (left side viewed) a ridge running back and somewhat down, crossing upper angle of operculum and continuing on to trunk for about the same

distance; arising above from this three parallel backwardly oblique ridges, the hindmost (longest) reaching almost to dorsal profile half an eye diameter in advance of dorsal origin, the three being terminated by a strong linear ridge slanting downward and forward; an oblique ridge along pectoral base and below this two short curved ridges, anterior directed somewhat forward, posterior somewhat backward.

Ventral surface forming a narrow platform, virtually flat behind, somewhat rounded in front. Most of both profiles not accounted for by fins traversed by a low vitreous ridge or line of spines; from beneath eye to just short of vent this takes the form of 8 spiniferous scutes, the earlier longer, with largely adnate median keels briefly free and acute posteriorly, the later shorter with well developed more elevated spined terminations; on dorsal surface in advance of first dorsal fin a line of obscurely developed projections of which the last half dozen near the fin constitute recognizable small spines; the short subhorizontal interdorsal with about 16 minute spines, more conspicuously developed in the hind one-third or so of the series. (The presence of the spines other than those of the ventral scutes may be associated with immaturity). Virtually whole surface of fish covered with rugose bony plates embedded in rough scales; presenting to the naked eye a pattern of closely set longitudinal ridges of variable length, in places breaking up into short keels and small bosses; under a lens each plate is seen to bear one or more bosses and/or irregular rugosities. Supraorbital not dentate.

Second dorsal spine inserted at 0.66 of L_s , in advance of level of vent (0.70), closer to head than to caudal base, shorter than (0.75) snout; somewhat compressed but with both sides distinctly convex, with 3 subparallel longitudinal ridges; proximal half of hind border with 4 long slender spinules, almost wholly adnate, their length less than their interspaces; base of fin less than interdorsal, greater than base of second dorsal between parallels but less when both measured obliquely. Anal originating under hind part of first dorsal, terminating shortly behind second dorsal, its oblique base double that of that fin. Caudal slightly emarginate, its length about one and a half eye. Pectoral small, about one-third head, failing to reach level of first dorsal. Ventral minute, inserted at 0.6 of standard length, a little in advance of level of first dorsal spine.

COLORATION

Upper one-third of snout blackish, rest greenish, with some small brownish spots, anteriorly becoming somewhat silvery. Above a line from upper one-third of orbit, following the dorsal profile at a little more than one-third of an eye diameter from it, to just above middle of caudal peduncle, dark bluish, rather sharply demarcated from rest of side, which is dusky silvery progressively becoming more silvery downward. Second dorsal spine dusky greenish in anterior half, pale yellowish in posterior half, other spines translucent. Other fins pale yellowish. Whitley & Allan (1958: 71) state, 'This species [here referred to *Orthichthys* Gill, 1862, a genus that does not appear to have been noticed by any other Australian writer] is grey in colour to bluish and silvery, instead of rosy red to yellowish as in *Macroramphosus*'. However, in the Handbook (Munro, 1958: 95) the present species (as *M. molleri*) is described as 'pink', with a specification of 'Silver, darker above' given for *M. velitaris* (Pallas, 1770).

ASPECTS OF FORM

1. *Length of head, length to vent, standard length.* In a loglog plot these three dimensions are, as in many diverse species, significantly linear on three early natural numbers, here 1 2 4.

$\log L = 0.5474 \log N + 2.6726; t = 43.054^*$; estimated (measured) lengths, $T L_s$, 471(468) 720(695) 1 005(1 000).

2. *Profiles.* Measurements of height above and of depth below midlateral line between most advanced point and middle of end of caudal peduncle have been made at 10 equal intervals and 3° and 4° polynomials calculated.

Dorsal profile: $H = -31.56 + 34.741N - 1.11113N^2 - 0.185896N^3; R 0.9954$;
estimated (measured) heights, TLs , 1.9(5.1) 32.0(25.6) 57.6(61.5) 77.7(76.9) 91.1(84.6)
96.7(102.6) 93.4(102.6) 80.0(76.9) 55.6(43.6) 18.8(25.1).

$H = -4.79 + 0.4138N + 11.44940N^2 - 1.902241N^3 + 0.0781572N^4; R 0.9967$;
estimated heights 5.3 27.8 54.5 78.3 94.6 100.3 94.3 77.5 52.4 23.6.

Ventral profile: $D = -46.9 + 81.5675N - 11.29564N^2 + 0.384768N^3; R 0.9840$;
estimated (measured) depths, TLs , 23.9(28.2) 74.2(64.1) 107.0(107.7) 123.4(128.2)
126.7(130.8) 119.1(115.4) 102.7(102.6) 79.8(82.1) 52.9(48.7) 24.1(25.6).

$D = -27.58 + 56.9389N - 2.28383N^2 - 0.846660N^3 + 0.0559740N^4; R 0.9858$;
estimated depths 26.3 71.3 104.4 123.8 129.2 121.5 103.1 77.5 49.9 26.5.

Both the 3° and the 4° equations are reported to make evident a point of possible interest to the taxonomist. Though the increase in goodness of fit in proceeding to an additional term as measured by R is seen to be of small moment, with the overall gain not formally statistically significant (for dorsal 4° F is 1.647, for ventral 0.644), the higher degree curve is perhaps likely to be of greater interest to the practising systematist by virtue of the decidedly better estimates it provides of the initial and terminal variates specifying the front and back of the fish. Thus for the present data the percentage variation of estimated from measured values for the first two and last two deciles of the dorsal and ventral curves pooled is for the 3° equation 6.63, \bar{x} 23.3, for the 4° 3.24, \bar{x} 8.3, with the advantage in the case of each measurement in favor of the 4° equation. The situation is a usual one—Snedecor (1950) observed that the third degree polynomial 'exhibits certain snakelike curves'—and the discrepancy is even more marked than here in the corresponding curves for *M. elevatus* noted below.

3. *Indexes of depth.* The conventional item in specific diagnoses, (maximum) 'depth in standard length' (exceptionally total length) may exhibit a considerable range to cover individual (in some species also age and/or sex) variation. An index that would seem at once likely to be more stable and to afford in many cases more general information (though providing a less satisfactory distinction between strongly peaked and highly rounded forms) and that might perhaps usefully be reported as a supplemental differentia is mean depth, here defined as the average of 10 measurements taken at equal intervals between most advanced point of body and end of caudal peduncle (hypural joint), the dimensions being cited as millesimals of standard length, TLs . For the present specimen the mean depth is 71.4 (contrast for our sample of *M. elevatus* 95.6). Two other useful indicators of body form are (a) the depth sequence, in which the serial numbers of the decile depths are arranged in order of ascending magnitude, here 1 10 2 9 8 3 4 \div 7 5 6 (in some interspecific studies separate sequences of depth below and height above the anteroposterior axis could well prove of value), (b) the ratio $\Sigma H/\Sigma D$, where ΣH and ΣD are the sums of decile heights above and depths below the line between most anterior point—prosthiion (Gregory, 1928)—and middle of end of caudal peduncle—pygidion; for this fish this ratio is 0.73 (contrast *M. elevatus* 1.00). A more precise value for the ratio area above/area below anteroposterior axis, A_H/A_D , can of course be obtained by integrating the two polynomials between the limits 0 and 10.

Using the 4° equations we get $A_H = \int_0^{10} y_H dN = 545.4$ and $A_D = \int_0^{10} y_D dN = 812.5$, giving a ratio of 0.67 (for *M. elevatus* 1.02).

4. *Lengths to origins and terminations of vertical fins.* In a loglog plot the set $L = \{\text{length to first dorsal origin, anal origin, first dorsal termination, second dorsal termination, anal termination, caudal origin (}Ls\}\}$ yields a significantly straight line, $t 12.924^{***}$, on the abscissal set $N = \{3 4 5 6 7 8 10\}$, i.e., $L = b N^k$, with N a natural number.

$\text{Log } L = 0.3676 \log N + 2.6346$; estimated (measured) lengths, TL_s , 718(705) 779(746) 833(847) 881(901) 924(929) 1 005(1 000).

5. *Relative length of dorsal spines.* Only 4 dorsal spines were detected, with TL_s lengths 23 204 102 53. For *M. elevatus* with 5 it is found, see below, that in a loglog plot the lengths of the 4 members of the descendant set when taken in order cephalad are linear on the integers 1 2 3 10 (the spines other than the exceptional second thus being plotted on their reverse serial numbers). Measurements for the present fish, similarly treated, place the 3 members of the descendant set on the integers 1 3 10. Whether the omission here from the set found in the other species of an entry for the abscissal value 2 is individual and fortuitous, or whether it is a species character (with a suggestion the penultimate spine of the set of 5 characteristic of *M. elevatus* has been lost during evolution) remains conjectural.

DISTRIBUTION

Macrorhamphosus gracilis adds another to a growing list of species traditionally associated with New South Wales and Queensland that in recent years have been met with in Tasmanian waters, remaining unreported from Victoria and South Australia. While it is possible this may in part be attributable to differential collecting, it would seem likely our fish fauna includes a recognizable Eastern Australian component that does not normally extend to other adjacent States, the boundaries of the area involved corresponding more or less to those of the Peronian Marine zoogeographic region as recognized by Hedley (1903).

Macrorhamphosus elevatus Waite, 1899 (Fig. 1A)

Macrorhamphosus scolopax var. *elevatus* Waite, 1899, *Aust. Mus. Mem.*, 4(1): 59, pl.7 fig.1. Type locality: Port Hacking to Broughton Island, New South Wales (*Thetis*).

Centriscus scolopax: Johnston, 1883, *Pap. Proc. R. Soc. Tasm.* (1882) 123 (ex Allport MS) and *ibid.*, 1885 (1884): 254 and *ibid.* 1891 (1890): 34. Not *Centriscus scolopax* Linné, 1758 (type locality: North Atlantic and Mediterranean).

Macrorhamphosus gallinago Ogilby, 1908, *Proc. Roy. Soc. Qld*, 21: 92. Type locality: Tweed Heads, Queensland.

Macrorhamphosus lancifer Ogilby, 1910, New fish. Qld Coast: 90. Type locality: Off Cape Moreton, Queensland.

Macrorhamphosus robustus Ogilby, 1910, New fish. Qld Coast: 91. Type locality: Moreton Bay, Queensland.

Macrorhamphosus elevatus: McCulloch, 1911, *Zool. res. Endeavour*, 1(1): 23, text fig.8: Regan, 1914, *Ann. Mag. Nat. Hist.* (8), 13: 17: Lord, 1923, *Pap. Proc. R. Soc. Tasm.* (1922): 65, and 1927, *J. Pan-Pac. res. Inst.*, 2(4): 13: Lord & Scott, 1924, *Synopsis vertebrate animals Tasmania*: 8, 38: Phillipps, 1927, *N.Z. Mar. Dept. Fisher. Bull.*, 1: 19.

Macrorhamphosus elevatus: McCulloch, 1921, *Aust. Zool.*, 2(1): 32, pl.24 fig.90a, and 1929, *Aust. Mus. Mem.*, 5(1): 83: Whitley, 1948, *W. Aust. Fisher. Dept. Bull.*, 2: 14, and 1962, *Mar. fish. Aust.*, 2: 42, unnumbered fig., and 1964, *Proc. Linn. Soc. N.S.W.*, 89(1): 37, and 1968, *Aust. Zool.*, 15(1): 33: Munro, 1958, *Handbk fish. Aust.*, 23: 95, fig.653: Whitley & Allan, 1958, *Sea-horse and Relatives*: 70, colored pl. fig.5, text fig.21 No.1: Marshall, 1964, *Fish Great Barrier Reef and coast. waters Qld*: 108 pl.26 fig.118, and 1966, *Trop. fish. Great Barrier Reef*: 176, pl.26 fig.118.

Macrorhamphosus scolopax: Scott, 1961, *Pap. Proc. R. Soc. Tasm.*, 95: 55. Not *Centriscus scolopax* Linné, 1758 (type locality: North Atlantic and Mediterranean).

TASMANIAN HISTORY

Accepting an entry in Allport's MS list, Johnston included this species in his first catalogue (1883) as *Centriscus scolopax*, but remarked, 'It is questionable whether the Tasmanian species may not be *C. humerosus*, Rich. I have not yet examined any local specimens'. In the supplement to his Australian catalogue, under the heading *C. gracilis*, Macleay (1884: 42) wrote '*C. scolopax* I have never seen here. Mr. Johnston's *scolopax* is probably this species'. However, in an account of a specimen from Port Sorell, north-west coast, determined as *C. scolopax* Johnston stated (1885: 255) 'All my doubts about its existence in Tasmania are now set at rest'; adding 'It is very probable, however, that the two closely allied species, *C. gracilis* and *C. humerosus* also exist in Tasmanian waters'.

As *Macrorhamphosus elevatus* it appears in the two lists of Lord and in Lord & Scott without mention of any further records. Two specimens, not now available, identified as this species have been noted by the writer (1961): the smaller individual had an exceptionally short (apparently uninjured) second dorsal spine (two-thirds length of head, or 203 TLs; contrast 400-531 in the St Helens Point sample noted below), raising some possible doubt regarding its identity.

MATERIAL

A series of 5 specimens, L_s 52.5-78.1 mm, collected by Mr Shane Down at St Helens Point, east coast, in 60 fathoms (55 m) in June 1978 (Q.V.M. Reg. No. 1978/5/80); also a single dried example, L_s 76.6 mm, found at Lade's Beach, Bridport, north-east coast (Q.V.M. Reg. No. 1956/5/10).

MERICISTIC CHARACTERS

D. V, 11(1)-12(5). A. 18(2)-19(4). V. 1, 4. P. 13(3)-14(3). C. 6(4)-7(2) + 8(1)-9(5) + 5(2)-6(4).

DIMENSIONS

Morphometric data are set out in table 1. The coefficient of variation has been calculated for each dimension of the St Helens Point sample, not only providing a statistical measure of its variability but also affording (in the absence of size-related growth) an immediate pointer to its likely usefulness as a taxonomic specification.

DIAGNOSTIC PROPORTIONS

Proportions noted are those given above for *M. gracilis*; each records range and mean with standard error of the sample of 5, followed after a colon by the value for the single Lade's Beach specimen. Entries in parentheses preceded by M are those of the Handbook (Munro 1958), those preceded by W are from Waite (1899), if marked with an asterisk estimated from his illustration. Head in L_s 2.0-21, 2.08 \pm 0.0232: 1.96 (M 2.2-2.2, W 2.1*). Depth in head 1.5-1.9, 1.65 \pm 0.0842: 1.66 (M 1.3-1.8, W 1.42), in L_s 3.1-3.9, 3.26 \pm 0.136: 3.26 (M 2.9-4.3 W 1.55). Pectoral in head 2.2-2.7, 2.47 \pm 0.200: 2.48 (W 2.8*), in L_s 4.6-5.7, 5.15 \pm 0.404: 4.88 (W 6.0*). Snout in head 1.3-1.6, 1.49 \pm 0.0456: 1.63 (M 1.4-1.6, W 1.5*), in L_s 2.9-3.3, 3.21 \pm 0.0673: 3.19 (W 3.2*), in second dorsal spine 1.2-1.7, 1.46 \pm 0.229: 1.29 (W 1.3*). Eye in head 4.3-5.0, 4.59 \pm 0.116: 5.19 (M 5, W 5.5*), in snout 2.8-3.3, 2.97 \pm 0.192: 3.19 (W 3.6*). Interorbital in eye 1.4-1.6, 1.54 \pm 0.101: 1.51. Second dorsal spine in head 0.9-1.3, 1.08 \pm 0.154: 1.26 (M 'varying from 1.8 in head to longer than head', W 1.2*), in L_s 1.9-2.5, 2.24 \pm 0.122: 2.47 (W 2.4*). Maximum thickness in maximum depth 2.6-3.1, 2.92 \pm 0.193: 2.95, in L_s 9.6-10.3, 9.95 \pm 0.132: 9.62. Oblique (point-to-point) length of second dorsal base in L_s 10.4-14.9, 12.32 \pm 0.763: 14.93 (W 12.0*), ditto anal base 5.1-6.2, 5.48 \pm 0.185: 6.10 (W 5.5*). Oblique length of second dorsal base in oblique length of anal base 2.1-2.4, 2.23 \pm 0.0662: 2.45 (W 2.2*).

Of these ratios 6 exhibit statistically significant correlation with standard length, L_s , all correlations being negative.

Maximum depth in head	$r - 0.924$	$z 1.612$	$t 4.170^*$
Maximum depth in L_s	$r - 0.945$	$z 1.784$	$t 5.011^*$
Second dorsal spine in head	$r - 0.989$	$z 2.932$	$t 16.364^{***}$
Second dorsal spine in L_s	$r - 0.984$	$z 2.310$	$t 9.709^{**}$
Oblique dorsal base in L_s	$r - 0.954$	$z 1.736$	$t 5.521^*$
Oblique dorsal base in oblique anal base	$r - 0.9996$	$z 4.321$	$t 65.149^{***}$

Other ratios with a high, but not statistically significant, value of r are maximum thickness in maximum depth (+ 0.874), maximum thickness in L_s (- 0.834) and oblique length of anal base in L_s (- 0.871), all slightly below the value (0.878) for significance at $P 0.05$: these relations probably represent genuine biological situations—with these r values maintained, they would be formally significant statistically with one more degree of freedom, i.e., in a sample of 6. The high value for oblique dorsal base in oblique anal base is clearly fortuitous.

GENERAL FEATURES

Macrorhamphosus elevatus presents considerable resemblance to *M. gracilis* of which some account has been given above. It differs from it chiefly in the following features: (a) larger overall size (150 cf. 100 mm), (b) greater relative depth ($>$, cf. $\frac{1}{2}$ head), (c) second dorsal spine larger, longer (shorter) than snout, if depressed reaching about to level of end of caudal (to, or failing to reach, base of second dorsal), (d) this spine inserted much more posteriorly, about over (well in advance of level of) vent, nearer to (further from) caudal base than head, (e) spine much more strongly denticulate on posterior border, (f) largely reddish or yellowish, at times violet or bronze below (dark bluish above, greyish or silvery below), (g) possibly less pelagic (Waite 1899, 1900) than *M. gracilis*.

Second dorsal spine: stout, strongly compressed, its width at middle of length half its depth or less; tapering from a base with height about half an eye diameter to a tolerably pungent point; upper border essentially rectilinear, though somewhat convex proximally, where in all examples except (b) it is very briefly excavate to receive the minute first spine when depressed; on proximal two-thirds or so of posterior border some 10-18 spines, of which the first 4-8 are small closely set, in some cases representing little more than a denticulated ridge, the outer ones well separated, base broad, point obtuse or acute, straight or curved upward, spines occasionally double or two spines inserted close together one on either side; each lateral surface with up to 8 longitudinal ridges, mostly fine, one, closer to lower than to upper border, much more strongly elevated than the remainder; vitreous, more translucent towards tip.

COLORATION

After preservation in alcohol all the St Helens Point specimens are pale salmon above a line from upper part of eye to anal base, below this whitish or silvery; the darker color extends forward from eye as a pennon for rather less than half length of snout, the rest of which is of a pale biscuit or straw color. In all examples but one pectoral base blackish, and in all a small adjacent diffuse area of bluish black; no other noticeable discrete markings. All fin rays whitish or pale honey; second dorsal spine more or less honey colored, deepest, most golden proximally. The dried specimen is pale lustrous golden on the left side, mostly silvery on the right.

ASPECTS OF FORM

1. *Length of head, length to vent, standard length.* In a loglog plot these

dimensions yield a significantly straight line with as abscissae 1 2 3 (contrast *M. gracilis*, 1 2 4). The first equation below is that for the present sample, the length adopted being the arithmetic mean of the logarithms of the *TLs* magnitudes of the 5 individuals (i.e., the geometric mean).

$\text{Log } L = 0.6636 \log N + 2.6789; t 23.183^*$; estimated lengths (lengths back-calculated from mean logarithm), *TLs*, 477(480) 755(742) 989 (1 000). The corresponding equation for the Lade's Beach example is:

$$\text{Log } L = 0.6113 \log N + 2.7047; t 29.120^*; 507(509) 774(764) 992 (1 000).$$

2. *Profiles.* Procedure as for *M. gracilis* (see above); largest individual of present sample.

Dorsal profile: $H = -28.02 + 22.0428 N + 6.99714 N^2 - 0.882012 N^3; R 0.9740$; estimated (measured) heights, *TLs*, 0.1(10.1) 33.0(24.1) 77.3(68.4) 120.7(117.7) 146.9 (153.2) 165.6(170.9) 166.6(177.2) 144.5(149.4) 94.1(63.3) 10.1(25.3).

$H = 82.03 - 119.0534 N + 58.62552 N^2 - 7.936822 N^3 + 0.3206732 N^4; R 0.9972$; estimated heights 14.0 20.1 64.2 118.0 160.7 179.5 168.9 131.5 77.2 24.0.

Ventral profile: $D = -61.78 + 62.8663 N - 2.33841 N^2 - 0.324417 N^3; R 0.9715$; estimated (measured) depths, *TLs*, - 1.6(11.4) 52.0(36.7) 97.0(82.3) 131.5(138.0) 153.5(165.8) 161.1(167.1) 152.4(158.2) 125.4(122.8) 78.1(50.6) 8.5(25.3).

$D = 46.35 - 75.7682 N + 48.38923 N^2 - 7.256135 N^3 + 0.3150785 N^4; R 0.9958$; estimated depths 12.0 35.3 84.2 133.7 167.2 174.9 154.7 112.5 61.5 22.2.

See note on relative values of 3° and 4° equations under *M. gracilis*, above.

3. *Indexes of depth.* Mean depth 95.6. Depth sequence 1 10 2 9 3 4 8 5 7 6.

$H/D = 0.996$; or, integrating the 4° equations, $A = \int_0^{10} y_H dN = 980.0$ and $A_D = \int_0^{10} y_D dN = 964.1$ giving a ratio of 1.02.

4. *Lengths to origins and terminations of vertical fins.* The exponential relation between these lengths and between early natural numbers found for *M. gracilis* also obtains here with one modification, the lengths to the terminations of the second dorsal and the anal are virtually the same (mean logarithm of *TLs* for former 2.96570, for latter 2.96649); the arithmetic mean of these two values is here taken, in the loglog context, as the ordinate for 7, leaving 8 (occupied in *M. gracilis*) here empty.

$\text{Log } L = 0.2715 \log N + 2.7309; t 12.292^{***}$; estimated lengths (lengths back-calculated from mean logarithm), *TLs*, 725(736) 784(769) 833(818) 875(890) 913(925) 1 106(1 000).

For the Lade's Beach example the best straight line is:

$$\text{Log } L = 0.2603 \log N + 2.7401; t 11.449^{***}; 732(744) 789(791) 836(815) 876(898) 912(914) 1 001(1 000).$$

5. *Length of second dorsal spine relative to Ls and to snout.* Noting that variations in the length of the spine in *M. scolopax* were tabulated by Günther (1861 : 519), McCulloch (1914 : 23) stated 'I find similar though less striking variation in the Australian species, but it is always longer and usually much longer than the snout in *M. elevatus*, whereas it appears to be usually if not always shorter in *M. scolopax*.' Some quantification of the relative length of the spine is now possible. First, relative length, *TLs*, is

correlated positively with size of fish, r 0.977 (z 2.237), t 8.008*. The relation is an exponential one: with logarithmic length of spine, TL_s , on standard length, mm, the equation, on rectification, is:

$\text{Log } Sp = 0.005090 \text{ } LS + 2.3211, t 8.623^{**}$ estimated (measured) lengths of spine 523(531) 495(496) 429(416) 423(417) 388(400).

Secondly, the ratio snout in length of spine yields r 0.999 (z 3.617), t 32.183***. The ratio is linear on LS :

$Sp/Sn = 0.0218 \text{ } LS + 0.0385; t 32.253^{***}$; estimated (measured) ratios 1.741(1.730) 1.639(1.653) 1.371(1.359) 1.347(1.358) 1.183(1.180). While it may be assumed that form patterns involving such basic landmarks as length of head, length to vent and standard length (section 1, above) and locations of the vertical fins (section 4) exhibit species constancy; and, further, while the parameters of equations defining them could well be expected to present a noticeable degree of constancy between samples (as is found between the St Helens Point sample and the Lade's Beach individual); on the other hand considerable inter-sample variation would seem probable in the relation of the length of the large dorsal spine to that of the snout or to that of the fish as a whole. From the first equation above the estimated length of the spine of the Lade's Beach example would be decidedly greater (514 TL_s) than it is (403). From the second equation the estimated, measured values of the ratio are 1.71 1.29 for that individual, and 1.93 1.28 for the Port Sorell specimen reported by Johnston (1885: 255).

6. *Relative lengths of dorsal spines 2-5.* It has been found in a number of species of various families that where the spinous dorsal comprises an anterior ascendant set of spines followed by a descendant set (the modal pattern), the latter forms a series (or several series) characterized by the fact that when the spine lengths, taken in sequence cephalad, are plotted on loglog paper against their reverse serial numbers, i.e., counting forward, N' , the resultant graph is linear, $L = bN'^k$, or, rectified, $\log L = k \log N' + \log b$ (miscellaneous examples are to be found in a series of contributions to the papers and proceedings of the Royal Society of Tasmania from 1974 onward). Clearly this formulation could not apply unmodified in the present species with its exceptionally long second spine. However, it is found the pattern is preserved, with one (surely elegant) variation; the abscissae for spines {5 4 3} being, as usual, {1 2 3}, with spine 2 being located at 10 (cf. *M. gracilis*). With a spine number represented by N^a (a = arbitrary, in the sense that the members of the set are not {1 2 3 +} counting caudad, denoted by N , or {1 2 3} counting cephalad, N' , but are natural numbers departing in some way from the normal enumerative sequence, here with the run of 1 2 3 followed by disjunct 10), the relation holds for the 5 specimens with parameters as below.

- (a) $\text{Log } L = 1.4207 \log N^a + 1.3130; t 26.563^{**}$; estimated (measured) lengths, TL_s , 21(20) 55(53) 98(105) 542(531).
- (b) $\text{Log } L = 1.2823 \log N^a + 1.4045; t 39.189^{***}$; 25(26) 62(64) 104(97) 486(496).
- (c) $\text{Log } L = 1.2373 \log N^a + 1.3966; t 23.163^{**}$; 25(25) 59(56) 97(108) 431(416).
- (d) $\text{Log } L = 1.2331 \log N^a + 1.3844; t 39.145^{***}$; 24(25) 57(53) 94(97) 415(417).
- (e) $\text{Log } L = 1.2879 \log N^a + 1.3263; t 29.636^{**}$; 21(21) 52(50) 87(95) 411(400).

No measurements are available for the 1961 specimens.

7. *Relative total length of spines of descendant set.* It has been noted above (section 5) that the length of the second dorsal spine is a function of length of fish, and further (section 6) that the lengths of the spines of the descendant set are self-correlated. It is thus to be expected the sum of the lengths of the descendant set be a function of standard length.

$$\sum_2^5 L_s = 4.74 L_s + 313.37; t 16.480^{**}$$
; estimated (measured) sum of TL_s lengths
558(566) 599(592) 605(604) 673(663) 699(709).

8. *Relative depth.* It has been noted the relative depth of the body 'increases considerably' with age (McCulloch 1911: 23), but the relation does not appear to have been quantified. For our relation in the sample of 5 we find $r 0.963$ ($z 1.985$), $t 6.184^{**}$. The relation is a linear one. With depth (maximum) in TL_s units;

$$D = 2.265 L_s + 146.1; t 4.885^*$$
; estimated (measured) depths 265(257) 282(283)
284(285) 312(313) 323(320).

By extrapolation in fish L_s 50 and 100 mm the relative, TL_s , maximum depth of the larger fish could be expected to be 1.44 that of the smaller, justifying McCulloch's assessment that it 'increases considerably' with age. However, variation between samples is to be expected and is known to occur. For the Lade's Beach fish the predicted depth, TL_s , is 320, measured 306.

Table 1

Macroramphosus elevatus Waite, 1899

Dimensions of 5 specimens, (a)-(e), from St Helens Point, east coast, and one specimen from Bridport, north-east coast, Tasmania. First line standard length in millimetres, all other lines dimensions as millesimals of standard length.

Feature	(a)	(b)	(c)	(d)	(e)	(f)	V (a)-(e)
Standard length, mm	78.1	73.4	61.1	60.0	52.5	76.6	16.1
Total length	1173	1132	—	—	1152	—	1.8
Length to first dorsal origin	749	749	704	717	696	753	3.6
Length to first dorsal termination	835	808	818	808	819	815	1.4
Oblique length of first dorsal base	109	95	131	112	110	84	11.5
Length of first dorsal spine	38	27	30	28	32	29	16.8
Length of second dorsal spine	531	496	416	417	400	405	12.8
Length of third dorsal spine	105	94	108	97	95	94	17.0
Length of fourth dorsal spine	53	47	56	53	50	—	6.6
Length of fifth dorsal spine	20	25	25	25	21	—	10.7
Length to second dorsal origin	917	888	866	877	900	898	2.2
Length to second dorsal termination	953	924	912	910	922	918	1.9
Oblique length of second dorsal base	96	89	80	80	67	67	13.3

Continued overleaf

Table 1 Continued

Feature	(a)	(b)	(c)	(d)	(e)	(f)	V (a)-(e)
Length of longest dorsal ray	104	109	85	100	88	104	10.6
Length to anal origin	787	749	776	755	781	791	2.2
Length to anal termination	960	910	900	917	943	914	2.7
Oblique length of anal base	197	189	183	185	162	164	7.1
Length of longest anal ray	102	93	66	75	67	64	20.0
Length to pectoral origin	487	477	491	492	514	522	2.8
Length (total) of pectoral	193	177	219	200	187	205	8.1
Length to ventral origin	621	586	681	608	610	640	5.8
Length (total) of ventral	60	60	65	67	77	85	10.6
Head	474	470	483	473	501	509	2.7
Snout	307	300	306	307	339	313	5.4
Eye	102	109	103	108	101	98	3.5
Interorbital	65	68	67	67	74	65	5.0
Length to vent	773	722	735	733	747	764	2.6
Depth at front of eye	141	150	146	138	152	157	4.1

Continued overleaf

Table 1 Continued

Feature	(a)	(b)	(c)	(d)	(e)	(f)	V (a)-(e)
Depth at back of eye	220	225	223	200	198	235	6.1
Depth at opercular margin	297	326	278	260	272	287	9.0
Depth at vent	268	334	288	227	229	240	16.6
Maximum depth	320	313	295	283	257	307	8.6
Depth of caudal peduncle	51	54	51	50	53	54	3.2
Maximum thickness	104	102	98	102	97	104	2.9

FAMILY MORIDAE

'This very natural family' (Boulenger, 1910), the Cods, in the southern hemisphere of considerable and in the northern of great commercial importance, has been traditionally known as Gadidae, and the name Moridae makes no appearance in such standard works as those of Günther (1880), Jordan (1923), Boulenger (1910) or even in some recent texts as Laglar, Bardach & Miller (1962), nor is it found in such notable Australasian texts as the Australian Check-List (McCulloch, 1929), Castelnau (1872), Macleay (1881), McCoy (1878), Lucas (1890), Waite (1921, 1923), Whitley (1948, 1968), Hutton (1872, 1904) and Phillipps (1927). It may be noted the scope of Moridae as interpreted in the Handbook (Munro, 1957) Scott (1962) and Scott *et al.* (1974) is more restricted than that of the provisional classification of living teleosts of Greenwood *et al.*, (1966) the latter subsuming in it Tripterophycidae, treated as distinct by the Australian authors. For Moridae, based on Goode & Bean, 1896, as a senior synonym of Eretmophoridae Jordan, 1923, and Tripterophycidae Whitley, 1948, see Cohen (1975) and sources there cited. In proposing Tripterophycidae (with one Australian representative, *Tripterophycis intermedius* Whitley (1948a) had in mind an observation by Boulenger in describing *Tripterophycis* that this genus occupies 'an isolated position in the Phycine group of the Gadidae, being the only one to combine a tripartite dorsal fin with a single anal'.

Species hitherto reported from Tasmania number seven: (1) *Lotella callarias* Günther, 1863 (2) *Lotella swanii* Johnston, 1883 (type locality Tasmania) (3) *Physiculus barbatus* (Günther, 1863) (4) *Physiculus bachus* (Bloch & Schneider, 1801) (5) *Antimora viola* (Goode & Bean, 1878) (6) *Mora dannevigi* Whitley, 1948 (7) *Lepidion microcephalus* Cowper, 1956. In the Check-List (McCulloch, 1929) (2) is treated as a queried synonym of (1), and the identification of Johnston's species with Günther's has been generally accepted. Among local lists those of Johnston (1883, 1891) give (2) (3), a footnote in the earlier observing 'I have never seen a representative of *P. bachus* in Tasmania'; in his first list Lord (1923) had (1) (3) (4) but in his second (1927) he dropped (3) (? in error, intending to omit (4)); Lord & Scott 1924 list 1.3 (noting (2) as a synonym) and though including (4) give as reference not Bloch & Schneider 1801 but Richardson [1846] as *Lota breviuscula* (Waite (1923) also cited). The current situation is summed up by the recognition in the Handbook (Munro 1957) of all the species listed above with the exception of *Lotella swanii*.

During the course of a brief visit to the Queen Victoria Museum, Launceston in May 1980 Dr Daniel M. Cohen, Research Director, Systematics Laboratory, Marine Fisheries Service, Washington, determined in the Museum's collection two members of the family not previously recorded from Tasmanian waters, *Pseudophycis breviuscula* (Richardson, 1846) and *Physiculus marginata* (Günther, 1878). Dr Cohen has expressed the view that it is expedient some report of these additions to the Tasmanian faunal list should appear in a local publication, and with his courteous approval a formal notice of their Tasmanian occurrence is made here. Neither species is accorded a definitive Australian entry in the Check-List or the Handbook, though in the former Richardson's species appear in the synonymy of *Physiculus bachus* (Bloch & Schneider, 1801). It may be noted that the second binomen, *marginata*, preoccupies that of *Lotella marginata* Macleay, 1881 (type locality Port Jackson), a synonym of *Lotella callarias* Günther, 1863; for Macleay's species a *nomen novum* was proposed independently by Ogilby (1886), *limbata*, and by Rendahl (1920), *macleayi*.

Though one feature by which *Physiculus* Kaup, 1858 and *Lotella* Kaup, 1858 have traditionally been separated is that of the villiform bands of teeth in the jaws those in the outer row are enlarged in the latter and not in the former, it has been found 'some species of *Physiculus* have larger outer jaw teeth and have been misidentified as *Lotella* in many fish collections in Japan and elsewhere and probably in the literature as well' (Cohen, 1979). The characteristic difference in dentition, well illustrated in the paper cited (fig. 1) is that in *Lotella* there is an outer row or relatively large well spaced sharp-pointed teeth and an inner band of smaller teeth, while in those species of *Physiculus*

in which there are enlarged outer teeth these tend to be less widely spaced and do not show the marked discontinuity in size relative to the inner teeth diagnostic of *Lotella*. Tasmanian morids have in general not been the subject of intensive study and an examination of local material with this criterion in mind might be made with advantage. Another feature not commonly taken note of in Australian texts is the ventral light organ, present in *Physiculus* (and some other genera), lacking in *Lotella* (Norman 1937, Cohen 1979).

Genus *PHYSICULUS* Kaup, 1858

Physiculus Kaup, 1858, Arch. Naturgesch. (Wiegmann), 24(1): 88. Type-species, *P. dalwigkii* Kaup.

Physiculus marginatus (Günther, 1878)

Lotella marginata Günther, 1878, Ann. Mag. nat. Hist., 5(2): 19. Type locality: Pacific coast of south-western South America; Challenger stations 305-308; 120-345 fathoms (223-631 m).

Lotella marginata Günther, 1887, Rept. Zool. Challenger, 22(57): 86 pl. 14, fig. A: Thompson, 1916, Proc. U.S. Nat. Mus., 50: 425.

Physiculus marginatus Norman, 1937, Discovery Rept., 26(2): 53, fig. 24.

MATERIAL

Tasmanian record based on two examples, L_s 167 198 L_t 181 211 mm, taken by Mr J. Head from the stomach of a hapuku, *Polyprion oxygeneios* (Bloch & Schneider, 1801), in 225 fathoms (410 m) south from Pedro Blanca Rocks, off south-eastern coast on 4 November 1978 (Q.V.M. Reg. Nos 1978/49 1978/5/50).

Genus *PSEUDOPHYCIS* Günther, 1862

Pseudophycis Günther, 1862, Cat. fish. Brit. Mus., 4: 350. Type-species, *Lota breviuscula* Richardson.

Leptophycis Garman, 1899, Mem. Mus. Comp. Zool., 24: 350. Type-species, *Leptophycis filifer* Garman.

Physiculus Kaup, 1858, Arch. Naturgesch. (Wiegmann), 24(1): 88. Type-species, *Physiculus dalwigkii* Kaup.

Pseudophycis breviuscula (Richardson, 1846)

Lota breviusculus Richardson, 1846, Zool. voy. Erebus Terror, fish.: 61, pl. 38 fig. 1. Type locality: Bay of Islands, New Zealand.

Lotella bacchus: Günther, 1862, Cat. fish. Brit. Mus., 4: 347; Hutton, 1872, fish. N.Z.: 46.

Physiculus bacchus: Waite, 1911, Rec. Canterbury Mus., 1: 163, pl. 26 fig. 1; Phillipps, 1927, N.Z. Fisher. Bull. 1: 23 (reprinted without alteration 1971).

Physiculus (Pseudophycis) breviusculus: Whitley, 1968, Aust. Zool., 15(1): 40.

Phycis richardsoni Kaup, 1858, Arch. Naturg., 24(1): 89. Type locality: New Zealand.

MATERIAL

Tasmanian record based on an example, L_s 88 L_t 110 mm, collected by Mr Shane Down at Binnalong Bay, east coast, 15 May 1980 (Q.V.M. Reg. No. 1980/5/50).

FAMILY CREEDIIDAE

As recognized in the Check-List (McCulloch, 1929) the family Creediidae comprises only two species, *Creedia haswelli* (Ramsay, 1881), of which *Creedia clathrisquamis* Ogilby, 1898 is treated as a junior synonym, and *Squamicreedia obtusa* Rendahl, 1921. Ramsay (1881: 575) placed his species in the genus *Hemerocoetes* Valenciennes, 1837 in the family Trichonotidae, while in establishing his genus *Creedia* (named after J.M. Creed) Ogilby (1898: 298) found himself unable to refer it to any established family, contenting himself with a non-committal 'incertae sedis'. The adoption in the Check-List of the family Creediidae followed the action of Waite (1899: 63) in the course of his account of a specimen (the first known addition to the type material) taken during the trawling expedition of H.M.C.S. *Thetis*: the relevant volume of the *Australian Museum Memoir*, 4(1), includes an erratum slip correcting the test's 'Creediidae'.

Expressly treating the Trichonotidae as a 'catch-all' group Schultz (1960) in his report on the fishes of the Marshall and Marianas Islands provided a key for identifying 'the peculiar genera that are more or less related to the trichonotid-like fishes', including, among upwards of a score of genera, those referred in the Australian Check-List to Creediidae Limnichthyidae and Trichonotidae, all three of which, together with the allied Percophididae (which includes the Australian *Enimapercis* Whitley, 1936), were recognized by Jordan (1923) and by Berg (1940) and continued to be accepted as separate entities by Greenwood *et al.* (1966) in their provisional scheme of teleost classification, the last-named, however, subsuming Hemerocoetidae, treated as distinct by the earlier authors, in Percophididae. However, more recently Nelson (1978), dealing with the 13 species placed till then in the nominal families Creediidae and Limnichthyidae combines these families, the first name having priority. As thus constituted the Creediidae, of Indo-Pacific distribution, comprises 8 genera, *Creedia* Ogilby, 1898 *Limnichthys* Waite, 1904 *Schizochirus* Waite, 1904 *Squamicreedia* Rendahl, 1921 *Crystallodytes* Fowler, 1923 *Tewara* Griffin, 1933 *Chalixodutes* Schultz, 1943 *Apocreedia* de Beaufort, 1948, of which the first 4 are indigenous to Australia, all except *Limnichthys* which ranges widely being endemic.

No member of the Creediidae, *sensu lato*, was recorded from Tasmania in the Check-List. *Creedia haswelli* was not reported from our waters till more than fourscore years after its description.

Genus *CREEDIA* Ogilby, 1898

Creedia Ogilby, 1898, *Proc. Linn. Soc. N.S.W.*, 23(3): 298. Type-species, *Creedia clathrisquamis* Ogilby [= *Hemerocoetes haswelli* Ramsay].

Creedia haswelli (Ramsay, 1881)

(Fig. 2)

Hemerocoetes haswelli Ramsay, 1881, *Proc. Linn. Soc. N.S.W.*, 6(3): 575. Type locality: North Head, Port Jackson; 16 fathoms (29 m).

Creedia clathrisquamis Ogilby, 1898, *Proc. Linn. Soc. N.S.W.*, 23(3): 299. Type locality: Maroubra Beach, near Sydney.

Creedia clathrisquamis: Waite, 1899, *Aust. Mus. Mem.*, 4(1): 63, figs 6 6A 6B.

Creedia haswelli: McCulloch, 1929, *Aust. Mus. Mem.*, 5(3): 333; Scott, 1969, *Aust. Zool.*, 15(2): 170, figs 2a1 2a2 2a3 2b; Nelson, 1978, *N.Z. J. Zool.*, 5: 361.

ADDITIONAL MATERIAL

The first examples of this species recorded from Tasmanian waters, (a) L_s 34.8 L_t 40.5 (e) L_s 60.1 L_t 69.5, described and figured were taken in the vicinity of the Furneaux Islands, Bass Strait, in August 1966 (Scott, 1969: 170, figs 1, 2). Three additional specimens, (b) L_s 45.5 L_t 53.0 (c) L_s 49.5 L_t 56.0 (d) L_s 51.5 L_t 58.3, collected by Mr Shane Down 4 miles (6 km) north of Eddystone Point, east coast, Tasmania in March 1980 (Q.V.M. Reg. No. No. 1980/5/32) are here noted. For present convenience the five fish are lettered in sequence of increasing length.

MERISTIC CHARACTERS

In this and in subsequent sections where more than a single value is given the variates are cited in order of increasing length of the fish for which a count or measurement is available.

D.15 12 – 14 15? A.27 27? – 27 27? P.15/14 (left/right) 13 14 14 15/14. C., rays reaching hind border 10 11 10 11 10. L. lat. – 42 44 43 43. The dorsal count shows noticeable variation: Ramsay reported 14 for his *Hemeroacoetes haswelli*, while for the type of the synonymous *Creedia clathrisquamys* Ogilby gave only 12; an upper limit of 15 has been noted by Nelson and by the writer. The anal also exhibits marked variation ranging up from 24 (Nelson) to 28 (Ogilby). The pectoral range is from 12 (Nelson) to 15 (1969 material). Nelson observed that while Ramsay and the present writer both report C. 10 he counts only 8 or 9 rays: of the 3 present specimens 2 have 11 well developed major caudal rays.

Variation in fin counts is more pronounced in the Creediidae than in most groups. Thus even with variates for some species not noted, Nelson's survey of the family (*sensu lato*) includes half a dozen cases in which the anal count and the dorsal count exhibit a range of 3, together with one instance for each fin of a range of 4; recorded pectoral ranges are 2 (5 species) 3(1) 4(2).

DIMENSIONS

A series of dimensions of our east coast specimens is set out in table 5, those of the two Bass Strait fish being included, the pooled material being present in ascending order of standard length, with entries as T/ls . No significant correlation of size of variate with size of fish is apparent. However, consistently lower values are shown by this material – (b) (c) (d) – in respect of origins and terminations of both dorsal and anal fins together with the closely correlated length to vent. There are marked differences in the relative lengths of the pectoral and ventral, the mean of the former being 1.36 that of the latter in the 1966 specimens, or 1.52 as great as in the more recent material.

PROPORTIONS

Values of six proportional dimensions as T/ls noted by Nelson for *Creedia haswelli* are as follows (his ranges in parentheses). Body depth (maximum) 86-99, \bar{x} 96.1 \pm 2.563 (67-91), body width (maximum) 14-82, 64.1 \pm 6.380, orbit – 37 38 38 – (26-33), snout 55-61, 57.8 \pm 1.038 (49-61), predorsal length 576-632, 608.4 \pm 8.540 (587-640), preanal length 430-484, 454.6 \pm 10.152 (408-463).

Some further diagnostic proportions recorded by Ramsay (1881) Ogilby (1898) Waite (1899) and other authors for this and other members of the family may be noted. Eye 5.9-7.6, \bar{x} 6.61 \pm 0.301, orbit – 5.1 5.1 –, interorbital 33.3-51.8, 43.20 \pm 3.243, snout 3.2-4.1, 3.57 \pm 0.145, pectoral 1.0-1.7, 1.30 \pm 0.134, ventral 1.8-3.6, 2.46 \pm 0.351, depth of caudal peduncle 3.7-6.9, 4.91 \pm 1.99 all in head. Dorsal base in anal base 1.8-2.0, 1.87 \pm 0.0381, in length to origin of fin 2.3-2.6, 2.48 \pm 0.0610, in standard length 3.9-4.3, 4.07 \pm 0.0778.

GENERAL FEATURES

A tolerably detailed profile of the two examples from Bass Strait, accompanied by three figures of the head and one of the ventral fin, was given in the 1969 account. Some additions to and extensions or clarifications of those observations are noted below.

Mouth cleft extending to below from of eye (d) or 0.1 eye (b) (c) (cf. 0.1 0.2), maxilla to 0.6 0.5 0.5 eye (cf. 0.4 0.6). Interorbital very narrow, the low circumorbital ridges confluent with a pronounced median ridge extending briefly behind and somewhat more extensively forward of orbit. Beginning about one-third of an eye diameter behind eye and extending back for a distance subequal to that from its anterior border to level of front of orbit a subquadangular or somewhat rounded region, about as long as wide, defining the location of the upper surface of the hind-brain; this region, at the posterior border of which scalation ceases abruptly, conspicuous by virtue of discrete but intense blackish pigmentation, in marked contrast to the wholly immaculate flanking areas and to the immaculate or very sparsely and minutely peppered posterior squamous area; its existence was remarked upon by Waite (1899: 63). Preopercular border obscurely and irregularly crenate, at angle swinging well out behind subvertical preopercular ridge. Operculum more bluntly rounded than depicted by Waite (1899 fig.6), with a well-developed fan of striae, subtransparent, the slender branchiostegal rays clearly observable beneath it, border entire or slightly and indistinctly crenate.

Dorsal rays simple, increasing to 3rd or 4th thereafter decreasing evenly; last about one-third longest; anal rays simple, increasing to near middle of fin; pectoral rays simple, upper not much shorter than longest (4th-5th), lower 3-4 very short; ventral rays simple (for length, see below); caudal rays in general divided for half their length or more (cf. about one-third, 1969), the rami closely apposed; outermost ray or rays may be simple. Pectoral pointed superiorly, ventral rather pointed, caudal truncate. In (b) and (d) but not in (c) base of caudal overlapped by 2 or more scales. Ventral and pectoral longer than in earlier material, former extending 0.38-0.39 (cf. 0.21-0.28) of distance towards vent, latter failing to reach level of vent by 0.5-0.7 (cf. about full) length of postorbital head.

The conformation of the snout presents a curious problem to which the present material makes a somewhat unexpected contribution. Ramsay made no comment on the shape of the snout; Ogilby stated it is 'acutely pointed'; Waite observed of the *Thetis* specimen that apart from its greater size (52 cf. 37 mm) it differs from the type of *Creedia clathrisquamis* (to which species he ascribed it, being apparently unaware at that time of Ramsay's earlier *Hemerocoetes haswelli*) 'only by having the lower jaw the longer, possibly a sexual difference, and being of more pronounced colour'. (The possibility of the reported difference being of a seasonal rather than a sexual feature was mooted in the 1969 account). Nelson's contribution is confined to the specification 'Tip of maxilla notched'. In the smaller 1969 specimen, there and here denoted (a), in which the snout was undamaged, the upper jaw, which bears a stout subconical terminal process, its general sense forward but its minute tip somewhat upturned, projects by the extent of this process beyond the lower jaw which is strongly excavate between its expanded tip, with anterior border subvertical, and the beginning of the dentigerous portion of the jaw at about the anterior one-third of its length: the figure then presented has been redrawn and is reproduced here (fig.2 (a)). In each of the present specimens, in all of which the mouth is closed (open in the earlier example) the tip of the snout presents a difference conformation. In (b) it is turned somewhat upward, in (c) directed more or less forward, in (d) distinctly turned down, giving the impression of the terminal maxillary lobe, shown as pointed forward in the 1969 figure, being here swung down to embrace the partly hidden termination of the shorter mandible (figs 2(b) (c) (d)). In the light of the evidence at present available it would thus appear that when the jaws are open the upper projects beyond the lower, but when they are closed the greater part of the profile is constituted by the downward deployment of the movable tip of the upper jaw.

COLORATION

The overall color is whitish or deep cream; part or all of the hind border of some scales inconspicuously outlined by a narrow arc of usually sparse brownish or reddish brown punctulations, a feature subject to marked individual variation; the only constant discrete marking the dark patch on the occiput above the cerebellum.

ASPECTS OF FORM

1. *Length of head, length to vent, standard length.* These three dimensions exhibit the relation $L = bN^k$ where $N = \{1 2 4\}$. Rectified regression equations, measurements in TLs , are:

- (a) $\log L = 1.1361 \log N + 2.3176$; $t 125.725^{**}$; estimated (measured) lengths 208(207) 457(460) 1 004(1 000).
- (b) $\log L = 1.1299 \log N + 2.3163$; $t 56.856^*$; 207(209) 453(446) 992(1 000).
- (c) $\log L = 1.1757 \log N + 2.2867$; $t 37.379^*$; 194(196) 437(426) 987(1 000).
- (d) $\log L = 1.1823 \log N + 2.2857$; $t 81.225^{**}$; 193(194) 438(433) 994(1 000).
- (e) $\log L = 1.0825 \log N + 2.3454$; $t 65.301^*$; 222(223) 469(463) 993(1 000).

The parameters of the equation for the geometric mean are 1.1414 2.3101; $t 72.031^{**}$.

2. *Location of vertical fins.* The locations of the vertical fins are tolerably well specified by linear equations in which ordinal values are the set {logarithmic length to anal origin, dorsal origin, dorsal termination, anal termination, caudal origin (standard length)} and abscissal values the set {3 5 8 9 10}; dimensions being expressed as millesimals of standard length.

- (a) $\log L = 0.6199 \log N + 2.3803$; $t 23.113^{***}$; estimated (measured) lengths 474(484) 651(626) 871(876) 937(950) 1 000(1 000).
- (b) $\log L = 0.7156 \log N + 2.2826$; $t 121.508^{***}$; 421(420) 607(610) 849(843) 924(923) 996(1 000).
- (c) $\log L = 0.6831 \log N + 2.3084$; $t 35.522^{***}$; 431(437) 610(598) 842(835) 913(909) 981(1 000).
- (d) $\log L = 0.7004 \log N + 2.2894$; $t 20.084^{***}$; 420(430) 601(576) 835(832) 907(889) 977(1 000).
- (e) $\log L = 0.6443 \log N + 2.3610$; $t 35.352^{***}$; 466(471) 648(632) 877(886) 946(960) 1 012(1 000).

The parameters of the equation for the geometric mean are 0.6742 2.3229; $t 42.122^{***}$.

3. *Ventral fins.* The ray structure of the ventral fins presents some interesting features. Earlier (1969: 173, 174) attention was called to the fact that in the Tasmanian material the ventral count was 1, 4, while 1, 5 had previously been recorded; an illustration of the fin (fig.2b) was provided. Nelson (1978: 362), who had before him 7 examples including the holotype of *C. clathrisquamis*, remarked 'The specimens examined in this study all had but one spine and four soft rays in each pelvic fin, as did Scott's specimens, and not one spine and five soft rays as reported by Ramsay (1882)'. (It may be noted in passing that both here and in his References Nelson dates Ramsay's paper 1882; however, according to the Check-List (McCulloch, 1929: 333) the date of publication of the relevant part (3) of the volume for the 1881 session of the Linnean Society of New South

Wales was December 1881, and the year is confirmed by Whitley (1964: 103) in his bibliography of Australian ichthyology).

The number of pelvic rays is employed as a primary criterion by Nelson in his key to the Creediidae as recognized by him, 4 being found in *Creedia haswelli* and in the two species of the genus *Chalixodtes* Schultz, 1943, *C. tavensis* Schultz, 1943 and *C. chameleontoculis* Smith, 1956, 5 occurring in the remaining species keyed (other than *Apocreedia vanderhorsti* de Beaufort, 1948 in which pelvic fins are lacking). It would appear probable the lower ray count represents a reduction from a norm rather than a retention of a primitive character—a suggestion that receives support from the fact that Nelson examined one specimen of *Schizochirus insolens* Waite, 1904 having only 4, and the further circumstance that 'one specimen of what may be a new species of *Creedia* has a pelvic fin of 1, 3' (Nelson: 353).

The question may be raised, if one pelvic ray has been lost in the present species which ray is it? While there are a number of exceptions to the formula, in the great majority of five-rayed fins investigated the lengths of the rays are such that $1 < 2 < 3 < 4 > 5$ (5 =, commonly $>$, 3) — the ray counted as first here being taken, in accordance with the convention adopted in earlier general investigations into ray length-ray number relations (Scott, 1974b), as that farthest from spine, nearest to mediolateral line of fish. Lengths of the rays, TL_s , reported for the larger 1969 individual were 33 57 68 67, while for the present specimen (c), in which the fin is most readily measured, they are 81 97 103 101 (the greater size of the fin in the later material has already been noted above). If the condition found in the present species involves a reduction from the modal pattern specified above, the missing ray would not be the 5th but one of the 1st-4th. For a considerable number of species examined by the writer it has been found the logarithmic lengths of rays 1-4 are linear on the logarithms of 1-4 respectively. Hence if it be assumed the stated pattern was that from which the present fin was derived, it follows that if ray 4 were the one lost the best straight line in a loglog plot would be on 1 2 3, if ray 3 lost on 1 2 4, if ray 2 lost on 1 3 4, if ray 1 lost on 2 3 4. For the best straight line for the 1969 specimen the t values of these four arrangements in sequence as above are 7.237 1.856 24.529* 4.220; for specimen (c) 7.558 3.457 72.134** 5.380. It would appear, therefore, the ray that has been aborted may well be the 2nd, i.e., that adjoining the ray constituting both in the primitive and the present patterns the postaxial border of the fin. The relevant equations on logs 1 3 4 are:

(e) $\log L = 0.4149 \log N + 1.5171$; estimated lengths, TL_s , 33 58 67.
(c) $\log L = 0.1727 \log N + 1.9069$; estimated lengths, TL_s , 81 98 103.

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Table 5

Creediha haswellii (Ramsay, 1881)

Dimensions of 3 examples (b) (c) (d) from 4 miles (6 km) north of Eddystone Point, east coast, Tasmania (Q.V.M. Reg. No. 1980/5/32) and 2 examples, data from Scott (1969), from the vicinity of the Furneaux Islands, Bass Strait. First entry standard length in mm, all other entries millesimals of standard length.

Feature	(a)	(b)	(c)	(d)	(e)
Standard length, mm	34.8	45.5	49.5	51.5	60.1
Total length	1 164	1 164	1 131	1 132	1 156
Length to dorsal origin	626	610	576	598	632
Length to dorsal termination	876	843	832	835	886
Length to anal origin	484	451	430	437	471
Length to anal termination	950	870	889	909	960
Length to pectoral origin	175	200	184	186	184
Length of pectoral (total)	122	174	178	194	146
Length to ventral origin	182	176	172	165	186
Length of ventral (total)	57	105	98	102	77
Length to vent	460	446	426	433	463
Head	207	209	196	194	223
Snout	56	59	58	61	55

Continued overleaf

Table 5 Continued

Feature	(a)	(b)	(c)	(d)	(e)
Eye	32	27	28	33	36
Orbit	—	37	38	38	—
Interorbital	4	4	5	6	5
Depth (width) at front of eye	—(—)	44(44)	40(38)	39(39)	—(—)
Depth (width) at back of eye	52(56)	55(55)	53(42)	51(56)	57(63)
Depth (width) at opercular border	78(66)	88(66)	83(61)	89(62)	93(67)
Depth (width) at vent	59(—)	92(57)	93(42)	95(60)	84(—)
Maximum depth (width)	86(66)	95(68)	99(71)	99(62)	97(82)
Depth (width) of caudal peduncle	30(17)	43(13)	41(14)	52(14)	51(21)
Length of first dorsal ray	—	119	—	97	82
Length of longest dorsal ray	—	86	—	78	90
Length of last dorsal ray	—	40	—	39	32
Length of first anal ray	—	33	—	29	20
Length of longest anal ray	—	75	—	66	67
Length of last anal ray	—	18	—	16	23

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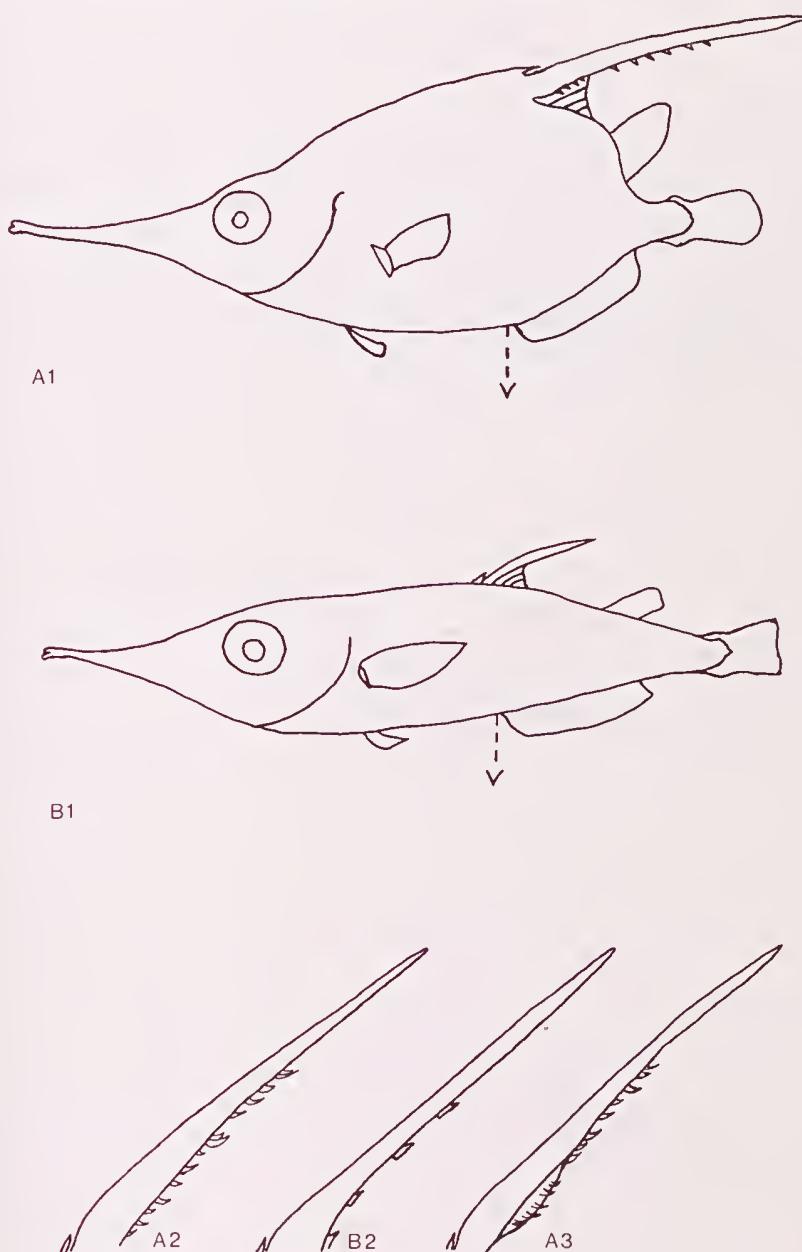


Figure 1

Legend: Fig. 1 — A, *Macrorhamphus elevatus* Waite, 1899. A1, general outline; A2, A3, second dorsal spine. B, *Macrorhamphus gracilis* (Lowe, 1839); B1, general outline; B2, second dorsal spine. Note in A greater depth, more anterior location of vent (V), bolder serration of hind border of spine.

Figure 2.

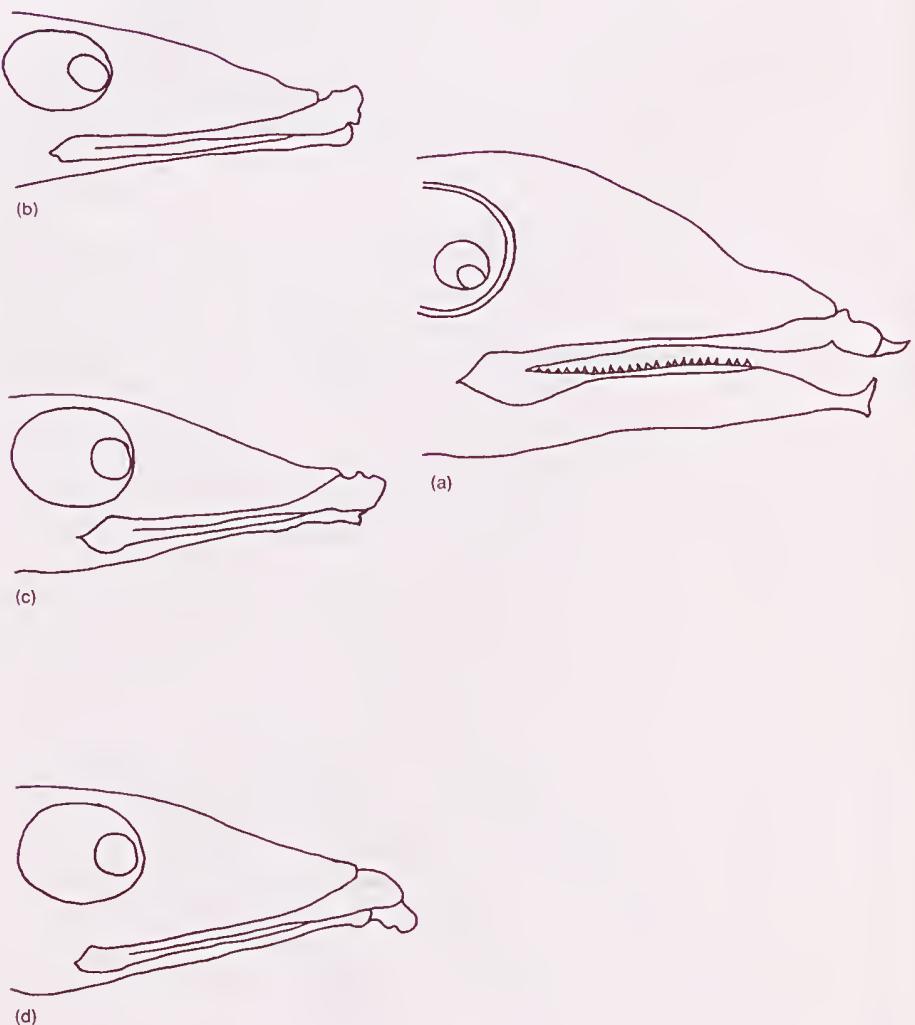


Figure 2

Legend: Fig. 2 — *Creedia haswelli* (Ramsay, 1881). Disposition of jaws; (a), with mouth open (redrawn from figure by Scott (1969) of a specimen from Bass Strait); (b), (c), (d), with mouth closed (3 specimens from 6 km north of Eddystone Point, east coast, Tasmania).

NOTE ADDED IN PRESS

A paper, "New locality records and preliminary information on demersal faunal assemblages in Tasmanian waters", by P. R. Last & T.G.K. Harris, in *Pap. Proc. R. Soc. Tasm.*, 115: 189-209, issued September 1981 while the present paper was in press, notes five Tasmanian specimens of *Physiculus marginatus* (Günther, 1878) as constituting the first Australian records for the species: an entry on p.1 of the present contribution specifies the Museum's two examples as the first reported from our waters. So the list of Tasmanian Moridae on p. (17?) here the paper cited adds *Tripterygycis gilchristi* Boulenger, 1904 and *Euclichthys polynemus* McCulloch, 1926 (the taxonomic position of the latter, treated as a morid in the Check-list (McCulloch 1929) and in the Handbook (Munro 1957), has been called into question (Svetovidov 1969) and remains in doubt).